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ABSTRACT

This report examines the experiences and contributions of the archival community--practicing archivists, manuscript curators, archival academics, and policy makers who work to define and promote the social utility of records and to identify, preserve, and provide access to documentary heritage regardless of format. The report addresses how the archival science perspective, which brings an evidence-based approach to the management of recorded knowledge, can make a major contribution to a new paradigm for the design, management, preservation, and use of digital resources. It traces the historical development of archival principles and practices and examines, with reference to key research and development projects, how they are currently being transformed into the digital environment to address issues including: information overload; dynamism in documentary forms; pervasive heterogeneity in information resources and media; documentation of relationships within and between resources; resource validation; granularity of description; and exploitation of context and structure in collections of documents. The report concludes with a discussion of what is needed from the archival, library, and other information communities engaged in the development and preservation of digital resources in order to achieve the full potential of cross-community dialog and development. (Contains 64 references.) (AEF)

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The Value of the Archival Perspective in the Digital Environment

by Anne J. Gilliland-Swetland

February 2000

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The Value of the Archival Perspective in the Digital Environment

by Anne J. Gilliland-Swetland

February 2000

Council on Library and Information Resources
Washington, D.C.

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Contents

Preface iv

Executive Summary v

Introduction 1

The Societal Role of Archives 3

The Archival Paradigm—Genesis, Rationales, and Evolution of Archival Principles 6

- The Sanctity of Evidence 10
- *Respect des Fonds*, Provenance, and Original Order 12
- The Life Cycle of Records 14
- The Organic Nature of Records 16
- Hierarchy in Records and Their Descriptions 18

Utility of the Archival Paradigm in the Digital Environment 21

- Integrity of Information 21
- Metadata 24
- Knowledge Management 26
- Risk Management 27
- Knowledge Preservation 29

Achieving the Full Potential of Cross-Community Developments in the Digital Environment 31

Summary 32

References 33

Preface

The Web is spawning a large mass of information of varying quality and value. From that huge, undifferentiated mass, librarians must sift carefully and assiduously to find material for their patrons that is valuable and trustworthy. Selecting published items for acquisition has presented many challenges over the years, but librarians have been trained to meet those challenges and to shape collections that best serve the needs of their users. What skills and practices will help them in the realm of electronic information?

As intellectual content migrates from print, film, and tape to electronic formats, it moves from a world characterized by the fixity and relative permanence of the medium into one in which the stability of the text is easily compromised, the permanence of the intellectual content hard to ensure, and the means of accessing the information controlled by the user, not the creator, publisher, or librarian. The new forms of electronic communication often have more in common with unpublished materials and gray literature than with the materials librarians usually see. Even electronic journals pose problems of version control and challenges to long-term accessibility that are unknown in the print world.

In developing new tools and skills for assessing, acquiring, cataloging, and preserving this type of information, librarians often seek answers to questions that archivists and other information specialists have dealt with for years. As Anne Gilliland-Swetland persuasively argues in this report, digital technology is erasing many of the distinctions between custodians of information and custodians of artifacts—museum curators, librarians, archivists, and information technology specialists. This report provides an overview of the roles that archives and archivists have traditionally played in collecting and managing historical evidence. The author describes how archivists are relying on old theoretical approaches while developing new skills to grapple with the avalanche of electronic records. In clarifying the roles that process and context play in determining the value and integrity of electronic records, she offers to librarians and other information specialists fresh insights into how digital information behaves, carries meaning, and gains (or loses) value for users over time.

The differences between archives and libraries will continue to be significant. While archivists deal with only one type of document—a record—libraries deal with many. And while archivists are responsible for information within a controlled environment, librarians routinely handle information that crosses many technological and administrative barriers in the course of its life cycle. Nonetheless, digital technology is creating an information landscape characterized far more by fluid boundaries than fixed landmarks. The old paradigms of information collection and custody demand re-examination, and the archival perspective offers many promising directions for librarians in the digital future.

Abby Smith
Director of Programs

Executive Summary

As the digital information environment has expanded and diversified, so too has the community of professionals responsible for designing, managing, disseminating, and preserving digital information resources. This community, really a metacommunity, includes librarians, archivists, preservationists, museum professionals, information system designers, technical information specialists, and sometimes information creators themselves, brought together not only by new opportunities but also by common concerns. Each of these parties has a unique perspective developed from its societal role and manifested in specialized paradigms and practices.

Rapid development and widespread implementation of networked digital information technology has presented this metacommunity with unparalleled opportunities to enhance the processes of knowledge creation and use. These opportunities, however, come coupled with critical and often seemingly intractable issues relating to the heterogeneity, scale, validation, information life cycle, and intellectual accessibility of digital resources. Not even the bibliographic practices of the library and information science communities, which are the most extensively articulated and widely implemented in information systems, can be applied universally and effectively to address these issues. The paradigms of any of the information professions come up short when compared with the scope of the issues continuously emerging in the digital environment. An overarching dynamic paradigm—that adopts, adapts, develops, and sheds principles and practices of the constituent information communities as necessary—needs to be created. Such a paradigm must recognize and address the distinct societal roles and missions of different information professions even as boundaries between their practices and collections begin to blur in the digital environment.

This report examines the experiences and contributions of the archival community—practicing archivists, manuscript curators, archival academics, and policy makers who work to define and promote the social utility of records and to identify, preserve, and provide access to documentary heritage regardless of format. The report addresses how the archival science perspective can make a major contribution to a new paradigm for the design, management, preservation, and use of digital resources. The archival perspective brings an evidence-based approach to the management of recorded knowledge. It is fundamentally concerned with the organizational and personal processes and contexts through which records and knowledge are created as well as the ways in which records individually and collectively reflect those processes.

The report traces the historical development of archival principles and practices and examines, with reference to key research and development

projects, how they are currently being transferred into the digital environment to address issues that include the following:

- life cycle control of high-volume, dynamic multimedia collections of born-digital and digitized materials, from creation through final disposition;
- establishment and preservation of the integrity of digital materials;
- identification and preservation of the evidential value of digital materials through design, description, preservation, and evaluation of information systems;
- exploitation of context and hierarchy in the design and use of digital materials;
- elucidation of the nature, genesis, and use of digital materials by their creators; and
- identification and exploitation of the interdependencies among digital materials, related nondigital materials, and their metadata.

The report concludes with a discussion of what is needed from the archival, library, and other information communities engaged in the development and preservation of digital resources in order to achieve the full potential of cross-community dialog and development.

Introduction

> There is no doubt that in recent years a real shift has been occurring within which new or re-discovered record-keeping theories are emerging as fresh discourse, and equally that there are members of the record-keeping profession(s) now looking to see how the archival perspective can inform the conceptual models of other information professionals.
>
> —Upward and McKemmish (1994)

Today's conceptualization of who and what the information professions comprise has expanded and diversified in direct relation to the expanded conceptualization of what kinds of information resources and services make up or should make up the digital information environment. This broadened conceptualization encompasses everyone who manages information content as well as those who design, document, and exploit information context and structure. This includes librarians, archivists, curators, preservationists, technical information specialists, and information systems and museum professionals. The important roles played by the creators of digital information are also being recognized.

The drive to develop transparent, networked, multimedia, multirepository resources has brought these professional communities and information creators into a new metacommunity. The members of this metacommunity are converging around issues of metadata standards and interoperability, electronic record-keeping systems design, interface design, intellectual property, and professional education. Each community brings a unique perspective developed out of its societal role and manifested in specialized paradigms and practices. As a result, convergence requires that each community learn the others' vocabularies and the principles and practices to which they relate and determine what needs to be accommodated and where new practices need to be devised or new principles articulated.

The rapid development and widespread implementation of networked digital information technology has presented this metacommunity with critical and often seemingly intractable issues relating to the heterogeneity, scale, validation, and information life cycle of digi-

tal resources. Not even the bibliographic practices of the library and information science communities, which are the most extensively articulated and widely implemented in existing information systems, can be applied universally and effectively in addressing these issues. The paradigms of any of the information professions do not provide adequate guidance for addressing the scope and size of the issues continuously emerging in the digital information environment. This metacommunity needs to develop a dynamic paradigm that draws on those of its constituent communities. However, the metacommunity must also understand and account for the distinctiveness of the societal roles and missions of the different information professions as the boundaries among their practices and collections begin to blur.

The archival community is one of the smallest and, arguably, the least well understood of the professional communities working in the digital information environment and in knowledge management in general. The archival community comprises practicing archivists, manuscript curators, archival academics, and policy makers who work to define and promote the social utility of records and to identify, preserve, and provide access to documentary heritage regardless of format. Archival holdings are noncurrent organizational records of enduring value that are preserved by the archives of the creating organization. Manuscript collections, however, are also often collocated with archival holdings. Manuscript collections are unpublished materials that are created or gathered by an organization or individual but are transferred from the original custodian to an archives, a historical society, or university library.

The archival perspective brings an evidence-based approach to the management of recorded knowledge. It is fundamentally concerned with the organizational and personal processes and contexts through which records and knowledge are created as well as the ways in which records individually and collectively reflect those processes. This perspective distinguishes the archival community from other communities of information professionals that manage decontextualized information and tend to be focused more on users, systems, or institutions.

In his 1958 address to the annual meeting of the Society of American Archivists, preeminent American archival theorist T. R. Schellenberg demonstrated with remarkable prescience his understanding of the exponential at work in twentieth-century information production resulting from the acceleration of record-keeping, information, and communication technologies. He predicted that archival practices, with their focus on the nature of materials, would be shaped by the dominant characteristics of those materials: their organic character, diverse form and content, and sheer volume. Schellenberg also predicted that these practices would be the archival profession's most important contribution to information management in general (Schellenberg 1959).

Exhortations for archivists to move beyond customary custodial roles and become advocates for information that must be preserved because of its enduring legal, fiscal, administrative, research or other

societal value (Dearstyne 1993) reflect a growing awareness among archivists that along with their concern for the nature of the materials, there is a critical need to promote the materials' long-term requirements and enduring value to society. Maintaining massive quantities of digital materials of continuing value over time, especially the evidential qualities of those materials, is essential but complex. The challenge of identifying and maintaining such materials has led archivists to work with information creators to design systems capable of keeping records that will endure with their evidential integrity intact and with the preservation community to provide testbeds and evaluation for new preservation technologies and processes. A review of recent preservation literature—especially that relating to digital materials—reveals an explosion in writing about preservation as it relates to archival concerns about intellectual integrity and a marked decline in literature about bibliographic preservation and preservation of the integrity of physical objects in general.

This report seeks to explicate the societal role and resulting principles and practices that together form the archival perspective and to identify their historical origins and evolution. It also discusses what the archival perspective offers in addressing issues that arise in the digital information environment, such as

- information overload,
- dynamism in documentary forms,
- pervasive heterogeneity in information resources and media,
- documentation of relationships within and between resources,
- resource validation,
- granularity of description, and
- exploitation of context and structure in collections of documents.

Examples of research and implementation projects illustrate how the evolving archival perspective is contributing significantly to the design, management, preservation, and use of digital resources.

The Societal Role of Archives

> [The archivist] exists in order to make other people's work possible, unknown people for the most part and working very possibly on lines equally unknown to him: some of them perhaps in the quite distant future and upon lines as yet unpredictable. His Creed, the Sanctity of Evidence; his Task, the Conservation of every scrap of Evidence attaching to the Documents committed to his charge; his Aim, to provide, without prejudice or afterthought, for all who wish to know the Means of Knowledge.
>
> —Jenkinson (1948)

The perspectives of different information professions tend to be understood in terms of their manifestation in the practices of physical

institutions. Over the past two centuries, a range of information institutions have evolved that play distinct roles within society. These roles reflect the many ways in which information is created, used, valued, preserved, and disposed of by individuals, organizations, and communities in the conduct of business, scholarship, learning, and personal affairs. Figure 1 outlines some of the distinct and overlapping activities of three major information institutions—libraries, museums, and archives—that today are increasingly engaged in both organizing and providing integrated access to digital information resources.

Figure 1 also shows how those activities project the societal roles, functions and values vested in a particular institution. Libraries, for example, are engaged in the tangible activities of identifying, acquiring, preserving, and providing access to published information. They are also engaged in less tangible, value-laden activities such as promoting intellectual freedom and serving as focal points for various communities.

It is assumed that seamless integration of information resources is a prerequisite for moving beyond the walls of individual physical institutions into virtual information space and knowledge construction practices. Transparency (i.e., rendering differences between diverse information resources invisible to end users) achieved through homogeneity in information retrieval methods and display of retrieved materials also seems to be important. Asserting individual institutional or professional differences always carries with it the potential to confuse the user and impede interoperability. It is important, however, to recognize that variant practices have arisen for sound intellectual and pragmatic reasons as institutions have fulfilled their various societal roles and managed their collections from diverse but equally legitimate perspectives. A new paradigm needs to be created that will facilitate the right blend of commonality and distinctiveness. We need to better understand when it is useful to maintain distinctions and when it is useful to create transparency so that we can ask to what extent each community's practices and principles might endure and in what form.

The Society of American Archivists (Bellardo and Bellardo 1992) defines archives as "(1) The 'non-current records' of an organization or institution preserved because of their continuing value; the term 'archival records' or 'archival materials' signifies any physical medium which is employed to transmit information, such as paper, photographs, audio or video tape, computer tapes or disks, etc. (2) The 'agency or program' responsible for selecting, preserving, and making available archival materials; also referred to as an 'archival agency.' (3) The 'building' or part of a building where such materials are located."

Additional definition is required to help us understand more fully the roles that archives can and should play in the digital environment. First, archival institutions serve an important legal function in society. Archival institutions are generally legally constituted entities responsible for identifying, managing, and preserving the integrity

Libraries

- Identify, acquire, preserve, and provide access to the world's published knowledge
- Promote equity of access to information
- Promote intellectual freedom
- Support education and continuous learning and research
- Support the development of information literacy in society
- Serve as focal points for communities and promote community interests

Museums

- Identify, acquire, preserve, and exhibit unique, collectible, or representative objects
- Promote cultural, community, and familial identity and understanding
- Provide experiences where visitors can make connections between content and ideas
- Serve as memory institutions for a culture
- Support formal and informal learning and research
- Serve as focal points for communities and promote community interests

Archives

- Identify, appraise, preserve, and make available documentary materials of long-term value (essential evidence) to the organization or public that the archives serves
- Ensure the accountability of government by preserving public records and making them available to the citizenry as is legally and ethically appropriate
- Ensure the accountability of nongovernmental institutions to their shareholders, boards, and other constituents
- Preserve unique or collectible documents
- Serve as memory institutions for a culture
- Support scholarly, administrative, and personal research

Fig. 1. Societal roles of major information institutions

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of an institution's official records of long-term value. These activities prove the actions of the institution and provide essential protection for the institution's legal rights and those of its constituents or the general citizenry. Archival institutions enable legally constituted access to records, access that must also constantly address a range of legal concerns that become more pressing in the digital environment. These concerns include intellectual property, the privacy of individuals mentioned in materials, the conditions under which certain types of materials can be accessed and made available, and the protection of the integrity of digital materials from accidental or deliberate tampering. Concern for retaining the evidential value of records has placed the archival community at the vanguard of research and development in digital preservation and authentication.

Second, because archives focus on records, archivists have an awareness of the societal, institutional, and individual construction of memory and an understanding of the implications of how that memory is represented and transmitted over time. This awareness becomes increasingly important as more of the world's collections are reformatted and represented online. It is also important for retaining evidence in time and over time, especially through digital preservation processes.

Third, libraries have focused predominantly on the organization, dissemination, and use of existing information (traditionally in published form, but this is changing rapidly), archives focus on these activities too, but are also intimately engaged in the creation of information and its ultimate disposition (either destruction or permanent retention). Since the 1960s, the archival community has worked closely with the creators of records and record-keeping systems to develop means to identify and preserve digital records that have no paper counterpart. The problem of what to do about records that are born digital has forced archivists to reexamine and reinvent their principles and practices in light of a digital challenge that emerged before the advent of digital libraries. This engagement at various points in the life cycle of materials also helps to establish a bridge to information and knowledge production processes and communities—from electronic publishing to digital asset management—that have traditionally fallen outside the domain of bibliographic information.

The Archival Paradigm—The Genesis and Rationales of Archival Principles and Practices

> The quest for knowledge rather than mere information is the crux of the study of archives and of the daily work of the archivist. All the key words applied to archival records—provenance, *respect des fonds*, context, evolution, inter-relationships, order—imply a sense of understanding, of "knowledge," rather than the merely

> efficient retrieval of names, dates, subjects, or whatever, all devoid of context, that is "information" (undeniably useful as this might be for many purposes). Quite simply, archivists must transcend mere information, and mere information management, if they wish to search for, and lead others to seek, "knowledge" and meaning among the records in their care.
>
> —Cook (1984)

Archival theory, methodology, and practice together constitute archival science. Because archival science is scholarly as well as practical and uses a distinct methodology to gain knowledge, it can be considered both a discipline and a profession (Livelton 1996). The disciplinary and professional aspects of archival science together compose the archival paradigm—a set of assumptions, principles, and practices that are common to the archival community and are a model for its activities and outlook.

Although archives have existed for thousands of years, much of the archival paradigm—not unlike that of library science—coalesced between the mid-nineteenth and twentieth centuries. Several key treatises and manuals codifying archival theory and practice were published between 1830 (when François Guizot, French Minister of Public Instruction, issued regulations requiring the application of *respect pour les fonds* to the records of the *départements* in the Archives Nationales) and 1956 (when T. R. Schellenberg, an archivist at the U.S. National Archives and Records Administration, published *Modern Archives: Principles and Techniques*, containing an American delineation of the archival paradigm). The most influential of these was the *Manual on the Arrangement and Description of Archives*, written in 1898 by Dutch archivists Muller, Feith, and Fruin, which brought together the French and Prussian ideas of *respect des fonds* and provenance. The translated manual was widely disseminated and was a major topic of discussion when librarians and archivists met for the first time for an international congress at the 1910 World's Fair in Brussels. As a result, the concept of provenance was adopted by the congress as the basic rule of the archival profession (Van den Broek 1997).

The archival paradigm has been extensively influenced by the so-called auxiliary and ancillary disciplines—diplomatics, history, law, textual criticism, management and organizational theory, and library science. Perhaps most influential have been the research methods of modern scientific history and legal theories of evidence that developed during the nineteenth century largely from diplomatics. Diplomatics was developed to help establish the authenticity of medieval ecclesiastical records. It is the study of the genesis, forms, and transmission of archival documents; their relation to the facts represented in them; and their relation to their creator, in order to identify, evaluate, and communicate their true nature (Duranti 1998a). As a result of these influences, most of the archival community working with public records focused on developing principles for archival arrangement and description that emphasized the organic

nature of records and the circumstances of their creation. The manuscript community and some national archives, however, adopted bibliographic practices of subject control (Duranti 1998b). In the United States, where the archival profession was only just beginning to coalesce, historian and later archivist Waldo Gifford Leland presented a paper at the First Conference of Archivists in 1909 calling for the reorganization of archives according to the principle of provenance rather than library methods. In a report on the Illinois State Archives, Leland wrote that an administrative history must be prepared for each office and that the archives should be classified to reflect the organization and functions that produced them (Brichford 1982).

The bifurcation of public archives and historical manuscript descriptive practices in the United States can most easily be explained in terms of prospective use and archival setting. For archivists administering records programs within their own institutions, the primary uses of records were legal proof and administrative research, often conducted by the records creators. For those engaged in manuscript administration, the focus was on secondary use by historical scholars, often in a research library, where there was more pressure to apply bibliographic models of description (Gilliland-Swetland 1991). Arguably, therefore, library science has influenced archival science less through the contribution of specific practices than through the encouragement of greater emphasis on access and user orientation.

Archivists and the bibliographic community worked together to increase use and facilitate access to archival and manuscript holdings. In 1983, they developed the machine-readable cataloging (MARC) archival and manuscripts control (AMC) format to describe their holdings. Their goal was to integrate standardized information about archival holdings into bibliographic utilities and online public access catalogs and encourage wider use of the holdings. Although MARC AMC was widely adopted by university archivists as well as many state and local historical repositories, many archivists were not comfortable with what they perceived to be the forcing of archival descriptive practices into a data structure that was still essentially bibliographic. In 1993, work began on encoded archival description (EAD), which took the core archival descriptive tool—the finding aid—and used it to develop a standard generalized mark-up language (SGML) document type definition. This definition could be used to disseminate archival descriptive information on the World Wide Web and could be mapped onto other kinds of descriptive metadata in digital information resources.

In the United States, where archival practice developed later than in Europe, a whole new focus on the management of current records emerged between the 1930s and 1960s. Faced with vast quantities of modern records generated by two world wars and a huge federal bureaucracy and with early adoption of new record-keeping and reproduction technologies, archivists at the National Archives realized that they could not possibly keep everything. Thus, they developed revolutionary approaches that engaged archivists at the point of record creation in identifying active records of long-term

value and arranging for the orderly retiring of inactive records. This development had two important consequences: the addition to the archival paradigm of a new set of theories relating to life cycle management of records and appraisal and the establishment of the records management profession with the founding in 1956 of the American Records Management Association (now the Association of Records Managers and Administrators International).

From the 1970s until the early 1990s, the archival community in the United States hotly debated the extent to which archival principles and practices were based in theory versus expediency (Burke 1981, Roberts 1987 and 1990, Stielow 1991). In 1981, F. Gerald Ham said that technology and a changing social role for archives would lead to more active management of archival records and a reexamination of many basic assumptions about archival theory and practice. The debate gave way to the reexamination, as Ham predicted. Archivists needed to cope with emerging electronic record-keeping technologies, new modes of scholarly research (in particular the rise of social history and postmodern approaches to research), and increasing user expectations that archivists should provide automated information access.

The debate first centered on appraisal, the process by which archivists identify materials of long-term value. Issues discussed were what and how much to keep and how, in new electronic formats, to identify records in the often undifferentiated mass of digital information. Extensive discussion ensued about the need for descriptive standards developed from the archival perspective and how to reconcile the different descriptive traditions of the various information professions as well as within the archival community (Duff and Haworth 1993).

This debate has led to a reformulation and extension of core archival principles and practices. The archival community has argued that archival needs exist in wider information systems design and in the processes of document creation and preservation. It has also considered what its approaches have to offer in the wider realm of information management (Taylor 1993b). This is evidenced in a host of recent developments, discussed later in this report, such as EAD, the SPIRT Record-keeping Metadata Research Project in Australia, the Functional Requirements Project at the University of Pittsburgh, the International Project on Permanent Authentic Records in Electronic Systems (InterPARES) Project, and the Consortium of University Research Libraries (CURL) Exemplars in Digital Archives (Cedars) Project in the United Kingdom.

The essential principles supporting the archival perspective are as follows:

- the sanctity of evidence;
- *respect des fonds*, provenance, and original order;
- the life cycle of records;
- the organic nature of records; and
- hierarchy in records and their descriptions.

How these principles have evolved with regard to knowledge management in the digital information environment is discussed below. These principles reflect the concerns of a profession that is interested in information as evidence and in the ways in which the context, form, and interrelationships among materials help users to identify, trust, interpret, and make relevant decisions about those materials.

The Sanctity of Evidence

> History in the true sense depends on the unvarnished evidence, considering not only what happened, but why it happened, what succeeded, what went wrong.
>
> —Burke (1997)

Many of the information professions interact closely with other disciplines and derive much of their outlook from those relationships. For example, the practices and perspectives of information scientists have been strongly influenced by science and computer science. Archivists are closely aligned with professions such as law, history, journalism, anthropology, and archaeology. Evidence in the archival sense can be defined as the passive ability of documents and objects and their associated contexts to provide insight into the processes, activities, and events that led to their creation for legal, historical, archaeological, and other purposes. The concern for evidence permeates all archival activities and demands complex approaches to the management of information; it also sets high benchmarks for information systems and services, particularly with respect to archival description and preservation. Recently, the paramount importance of identifying and maintaining the evidential value of archival materials has been reemphasized, partly as a result of the challenges posed by electronic records but partly also to differentiate the information and preservation practices of the archival community from those of the library community.

The integrity of the evidential value of materials is ensured by demonstrating an unbroken chain of custody, precisely documenting the aggregation of archival materials as received from their creator and integrated with the rest of the archives' holdings of the same provenance, and tracking all preservation activities associated with the materials. Jenkinson (1937) described this process as the physical and moral defense of the record. Schellenberg (1956) expanded archival notions about evidence when he discussed the values that archivists should use to help them decide which materials to retain. The primary values of archival records are related to the legal, fiscal, and administrative purposes of the records creators; the secondary values are related to subsequent researchers. Schellenberg (1956) argued that the secondary values of public records can be ascertained most easily if they are considered in relation to "(1) the evidence they contain of the organization and functioning of the Government body that produced them, and (2) the information they contain on persons,

corporate bodies, things [e.g., places, buildings, physical objects], problems, conditions, and the like, with which the Government dealt." His argument acknowledges both the strict legal requirements of records that must be satisfied by archival processes and the wider concept of historical and cultural evidence that is contained in the materials and can be interpreted by secondary users.

The archival concern for the description and preservation of evidence involves a rich understanding of the implicit and explicit values of materials at creation and over time. It also involves an acute awareness of how such values can be diminished or lost when the integrity of materials is compromised. Evidential value in the widest sense is reflected to some extent in any information artifact, but only a subset of all information is subject to legal or regulatory requirements concerning creation and maintenance. Publications, for example, can be analyzed for evidence of the motivations and processes associated with their creation by studying their physical and intellectual form, examining different editions of the same work, and learning about the history of the publishing house or printer that produced them. Primary sources (unpublished or unsynthesized materials) particularly lend themselves to such kinds of analysis and interpretation, and such materials are increasingly being incorporated into digital information resources.

Maintaining the evidential value of information is important not only to creators of materials that are subject to legal or regulatory requirements but also to many researchers. In particular, reformatting, description, and preservation need to be considered. Reformatting has been discussed extensively in the professional literature in relation to the digitization of library and archival collections. Information professionals involved in digitally reformatting their collections must understand when a user may need to work with the original information object to appreciate some intrinsic characteristic, such as the weight of the paper; when a digital copy will do; and whether a copy needs to be high or low resolution, color or black and white. Information professionals must also decide how much of a collection needs to be digitized and what kind of metadata will enable a user to place information objects in context.

Archival practice places a premium on both collective and contextual description. The key is to explain the physical aspects and intellectual structure of the collection that may not be apparent and to provide enough contextual information for the user to understand the historical circumstances and organizational processes of the object's creation. Description should also demonstrate that the physical and the intellectual form of the materials have not been altered in any undocumented way.

Counterintuitively, perhaps, it is during the preservation of digital materials that evidential value is often most at risk of being compromised. Digital preservation techniques have moved beyond a concern for the longevity of digital media to a concern for the preservation of the information stored in those media during recurrent migration to new software and hardware. In the process, many of the

intrinsic characteristics of information objects can disappear—data structures can be modified and presentation of the object on a computer screen can be altered.

Respect des Fonds, Provenance, and Original Order

> The perfect Archive is *ex hypothesi* an evidence which cannot lie to us: we may through laziness or other imperfection of our own misinterpret its statements or implications, but itself it makes no attempt to convince us of fact or error, to persuade or dissuade: it just tells us. That is, it does so *always provided that it has come to us in exactly the state in which its original creators left it.* Here then, is the supreme and most difficult task of the Archivist—to hand on the documents as nearly as possible in the state in which he received them, without adding or taking away, physically or morally, anything: to preserve unviolated, without the possibility of a suspicion of violation, every element in them, every quality they possessed when they came to him, while at the same time permitting and facilitating handling and use.
>
> —Jenkinson (1944)

This cluster of principles represents the core tenets of archival theory and practice. Although the tenets are interpreted differently by different archival traditions, they nevertheless represent the essence of the archival perspective and its blend of intellectual and pragmatic rationales.

The principle of *respect des fonds* was first codified in 1839 in regulations issued by the French minister of public instruction. The principle stated that records should be grouped according to the nature of the institution that accumulated them. In 1881, the Prussian State Archives issued more precise regulations on arrangement that defined *Provenienzprinzip*, or the principle of provenance. The principle of provenance has two components: records of the same provenance should not be mixed with those of a different provenance, and the archivist should maintain the original order in which the records were created and kept. The latter is referred to as the principle of original order in English and *Registraturprinzip* in German. The French conception of *respect des fonds* did not include the same stricture to maintain original order (referred to in French as *respect de l'ordre intérieure*), largely because French archivists had been applying what was known as the principle of pertinence and rearranging records according to their subject content.

The benefits of *respect des fonds* are self-evident. Originally conceived of in physical terms, this principle facilitates physical and intellectual access to records generated and received by the same institution or person by gathering and describing them as an intellectual whole, regardless of their form, medium, or volume (Duchein 1983). The principle of provenance enhanced this approach by ensuring that the records remained as much as possible as they were originally created. From a practical viewpoint, the principle of original order

obviated the need for resource-intensive and contentious rearrangement according to subject. From an intellectual viewpoint, it preserved the objectivity of the records and provided insight into the functions, processes, and personal relationships of the records creator as reflected in the arrangement of the records (Gränström 1994, Schellenberg 1961).

In recent years, the conceptualization of these basic tenets has become more complex as bureaucratic structures have evolved and digital systems have been increasingly used for record keeping. Archivists have had difficulty establishing the provenance of records of multi-institutional collaborations or those contained in multifunctional databases and distributed information systems. In archival appraisal, more sophisticated conceptions of provenance, such as functional provenance and multiprovenance, have been developed for electronic records that apply business process analysis and functional decomposition. Functional provenance views the business function through which a record came into being as that record's provenance rather than the office or individual creating the record. This view is based on the rationale that record-keeping functions are likely to remain more or less constant whereas bureaucratic hierarchies and technologies shift over time. Multiprovenance recognizes that a record may be simultaneously created through the interaction of multiple offices or jurisdictions. In archival description, developments such as EAD and the Australian series system recognize that a one-to-many relationship may exist for groups of records created by changing bureaucratic structures. In the words of Australian archivists Frank Upward and Sue McKemmish (1994):

> The new [post-custodial] discourse has a new language, and is grounded in a new provenance theory. Structure no longer means only organisational structure; it can now mean the structures in which transactions are captured as records, including documentary forms and record-keeping systems. Context no longer means only record creators; it can now mean the agents of transactions operating in the context of their functions and activities. Functions and activities are no longer defined simply in terms of organisational charts; jurisdictions, competencies, and operational realities must be considered.

Taken together, *respect des fonds*, provenance, and original order ensure that the intellectual integrity of aggregations of records is maintained and that individual records are always contextualized. Adhering to these principles is a less resource-intensive way of providing access to high-volume collections than are classifying by subject and cataloging of individual documents. Considerable cataloging expertise and the availability of specialized standardized vocabularies are required for correct and consistent assignment of subject access points to heterogeneous unsynthesized and unpublished materials (Michelson 1987). Because the language used in archival materials is often archaic or technical, assigning a modern subject term that accurately reflects the concepts being expressed in

the records can be difficult. On the basis of their insight about how users working with historical and organizational materials might wish to search, archivists have broadened the notion of subject access, suggesting access points such as temporal and geographic coverage and form of material (Bearman and Lytle 1985, Bearman and Sigmond 1987, Roe 1990). Today we can see the application of such approaches in the resource type and coverage elements that have been integrated into the Dublin Core for use in resource discovery of networked electronic resources (Dublin Core Metadata Initiative 1999).

A huge volume of digital information has not gone through editorial and publication processes. Subject access and item control practices are not sufficient for effective and efficient organization of such information. The archival approach offers the concepts of collective arrangement and description according to the provenance of the materials; these provide benefits even when information managers or users are not interested in the evidential value of the materials. Applying these concepts makes it possible to unite related digital, nondigital, and predigital materials according to their intellectual rather than their physical characteristics. These concepts build context, which is a powerful and underused tool for facilitating understanding and ultimately creating knowledge. They prompt the user to consider the degree to which the material's source is authoritative. The archival approach focuses on the context, organic development, and content of the collection, allowing the user to ask the "how," "why," and "so what" questions so integral to research.

The Life Cycle of Records

> If we can become overarching information generalists with an archival emphasis, we will be able to bring to bear what should be a deep and thorough knowledge of the documentary life-cycle theory . . . it may be our most important asset in relation to (I do not say in competition with) our colleagues, the librarians and other information specialists.
>
> —Taylor (1993a)

The U.S. National Archives and Records Administration developed the concept of the records life cycle to model how the functions of, use of, and responsibility for records change as records age and move from the control of their creator to the physical custody of the archives. In the first phase of this model, administrators create and use records (in archival terms, primary use). Records creators must develop logical systems for classifying or registering records and implement procedures to ensure the integrity of the records. Records managers and archivists also ensure that active records are scheduled for systematic elimination or permanent retention. As records age, they gradually become less heavily referenced and finally become inactive. During the second phase, the archives is a neutral third party responsible for ensuring the long-term integrity of the

records. When the records enter the archives, they are physically and intellectually integrated with other archival materials of the same provenance, thus establishing the archival bond (Duranti 1996). Their physical integrity is ensured through preservation management; their intellectual integrity, through archival description. Archival records are then available for secondary use.

Changes in methods of record creation and in perceptions of their continuing value have recently led archivists to consider how to apply the life cycle model in a digital environment. The principles underlying the life cycle have been refined through projects such as Preservation of the Integrity of Electronic Records, conducted from 1994 to 1996 by archival researchers at the University of British Columbia (known as the UBC Project). An alternate model—the records continuum—has been proposed. This model now undergirds the conceptualization of the role and activities of the record-keeping professions in Australia and is gaining in acceptance in the United States and Europe.

The UBC Project sought to develop a generic model to identify and define by-products of electronic information systems and methods for protecting the integrity of the by-products, which constitute evidence of action (Duranti and MacNeil 1997). Using a deductive method drawing on the principles of diplomatics and archival science, the project identified the procedures necessary to ensure control over reliable records creation during the first phase of the records life cycle and to maintain the integrity of archival records during the second phase. The project reiterates the need in the digital environment for completed records placed under the jurisdiction of the archives.

The records continuum model takes a different approach. Records managers and archivists are involved with records beginning when a record-keeping system is designed. Physical transfer to the archives is not required; archivists establish requirements for appropriate maintenance of the records and monitor compliance by records creators. The intellectual interrelationships of active and archival records are established by integrating metadata from active records into the archival authority's information system (Upward and McKemmish 1994). This postcustodial model expands the role of the archivist to include active participation in the production and use of records.

The benefits of modeling the life cycle of information materials extend to information management in general by

- providing for the management of information resources from birth to death and identifying the points at which responsibilities for managing those resources change or certain actions must occur;
- integrating the communities responsible for creating, disposing of, and preserving information resources with those focusing on the organization and use of information;
- recognizing the motivations of different parties to ensure the integrity of information materials and points in the life cycle at

which those motivations become less compelling, thus putting the materials at risk;
- clearly elucidating the process of creating and consuming knowledge and using it to create new knowledge;
- making it possible to meet different user needs; and
- enabling prediction of levels of use and management of information storage requirements.

An example of the application of life cycle model in a nonarchival digital information framework is the Information Life Cycle model, developed at the 1996 National Science Foundation Workshop on the Social Aspects of Digital Libraries at the University of California, Los Angeles. This model (see figure 2) represents the flow of information in a given social system. It emphasizes the technologically based information storage and retrieval aspects of a digital library as well as the belief that digital libraries should be constructed to accommodate the actual tasks and activities involved in creating, seeking, and using information resources (Borgman et al. 1996).

The Organic Nature of Records

> Records that are the product of organic activity have a value that derives from the way they were produced. Since they were created in consequence of the actions to which they relate, they often contain an unconscious and therefore impartial record of the action. Thus the evidence they contain of the actions they record has a peculiar value. It is the quality of this evidence that is our concern here. Records, however, also have a value for the evidence they contain of the actions that resulted in their production. It is the content of the evidence that is our concern here.
>
> —Schellenberg (1961)

The practices of many information communities focus on the best and most cost-effective ways to organize and retrieve discrete information objects. Archival practice assumes that materials within a *fond* can be most effectively organized and retrieved collectively. Although collective management and description are pragmatic ways to gain basic levels of control over large quantities of heterogeneous information, for archivists the rationale behind these practices lies in the inherent characteristics of records and other materials that are the by-product of human activities. When materials are generated by the activity of an individual or organization, an interdependent relationship exists between the materials and their creator. A complex web of relationships also exists between the materials and the historical, legal, and procedural contexts of their development as well as among all materials created by the same activity. The organic nature of records refers to all these interrelationships, and archival practices are designed to collectively document, capture, and exploit them. These practices recognize that the value of an individual record is derived in part from the sequence of records within which it is locat-

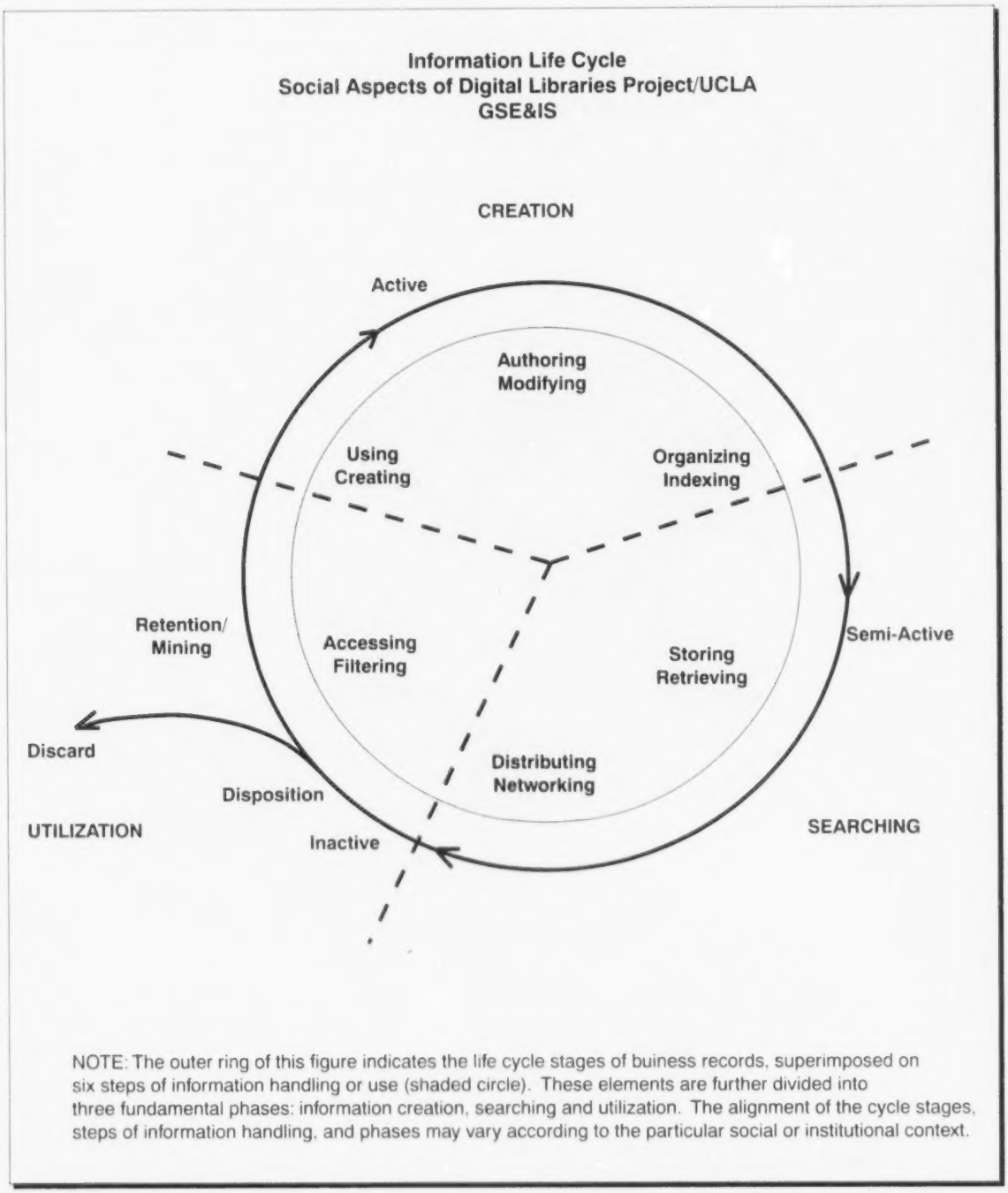

Fig. 2. Model of the life cycle of information in digital libraries (UCLA-NSF Workshop 1995)

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ed. They also recognize that it can be difficult to understand an individual record without understanding its historical, legal, procedural, and documentary context.

The perspective gained from working with information collectively can also be applied to the description, preservation, and use of Web resources. Resources created on the Web are not unlike archival *fonds* in that they include a complex of hyperlinks to pages related by provenance, topic, or some other feature. An advantage in the Web environment is that hyperlinks are explicit rather than largely implicit, as is the case with paper records. As a result, those who manage and use these resources can more easily identify and exploit organic relationships. A Web page without its hyperlinks may be less valuable to users because of its diminished evidential content.

Hierarchy in Records and Their Descriptions

Recent developments in information organization have exploited the structure of information content and its metadata to provide smarter access to materials, especially those that are hard to locate by subject or keyword. This is particularly evident in efforts to apply extensible mark-up language (XML) to develop structures that are more predictable for Web resources and in the application of the text encoding initiative for the SGML encoding of literary and historical texts.

Structure can be both intellectual and physical; it can exist within an information object, collections of information objects, and descriptions of those information objects. Archival practices explicitly recognize the existence of such structures and exploit those that are hierarchical. Developing and using hierarchies are intuitive ways for humans to model information; as a result, much information and many information systems have hierarchical characteristics.

To ascertain authenticity, archivists use principles derived from diplomatics to analyze how the intellectual form of records reflects the functions by which they were created. Diplomatics maintains that the intellectual form of records usually has three components—protocol, text, and eschatocol. Each of these components contains groups of additional elements of form; for example, the protocol contains elements such as the name of the author, the date the record was created, the name of the person to whom the record is directed, and the subject of the record. The eschatocol contains elements that validate the document, such as the official title of the author and signatures of witnesses and countersigners. When elements are absent or irregular, the records' authenticity may be questioned (Duranti 1998a).

Records have an innate hierarchy imposed by the creating agency's filing practices and position in a bureaucratic hierarchy and by the processes through which the records were created. A *fond* may contain *sous-fonds* or a record group may contain subgroups, which may in turn contain many series of records, each relating to a different activity. Individual record series may be divided into subseries

and even subsubseries, which may be further divided into filing units that contain individual documents.

Archival description, through inventories and registers collectively referred to as finding aids, has traditionally reflected these hierarchies. A high-level summary description provides basic intellectual control and collection management information for a set of records; progressively more granular descriptions are prepared for subordinate levels in the hierarchy. There are four advantages to this approach:

- It documents all the records of the same provenance, their arrangement, and the chain of custody that brought them into archival control.
- It permits economies in description. Collective description is less expensive than item-level description; this approach enables archivists to decide how far down in the hierarchy detailed description is needed on the basis of the values exhibited by the materials and the anticipated level and nature of use.
- For many kinds of historical and bureaucratic uses, this description mirrors the arrangement of the records and provides a logical way to search for materials.
- This approach can be applied regardless of the nature of a collection and does not require specialized description for special forms of materials.

In the digital environment, hierarchical and collective description lend themselves to hierarchical and object-oriented metadata structures such as SGML. The development since 1995 of the SGML document type definition for EAD has turned descriptive practices that may have seemed cumbersome into a powerful infrastructure for online information systems. A data structure standard for preparing encoded digital finding aids, EAD permits a collection to be searched at different levels of description and links to be built to descriptions of organically related materials or digitized versions of the materials. Figure 3 indicates the high-level model of the EAD document type definition and shows how the encoded finding aid has been broken into three major intellectual components:

- *eadheader*, which provides bibliographic and descriptive information about the encoded finding aid;
- *frontmatter*, which contains prefatory information about the creation, publication, or use of the finding aid; and
- *archdesc*, which describes the content, context, and extent of the archival materials being described.

Each component contains a hierarchy of nested elements, the most complex of which is *archdesc*. As indicated in the high-level model, *archdesc* contains many elements, each of which is also available for use at lower levels in the hierarchy. The LEVEL attribute indicates the level at which the element is occurring within the descriptive hierarchy. The tag for description of subordinate components (<dsc>) indicates how components at each level are further subdivided. Up to 12 numbered or unnumbered components can be nested within each <dsc> (Society of American Archivists Encoded Archival Description Working Group 1998 and 1999).

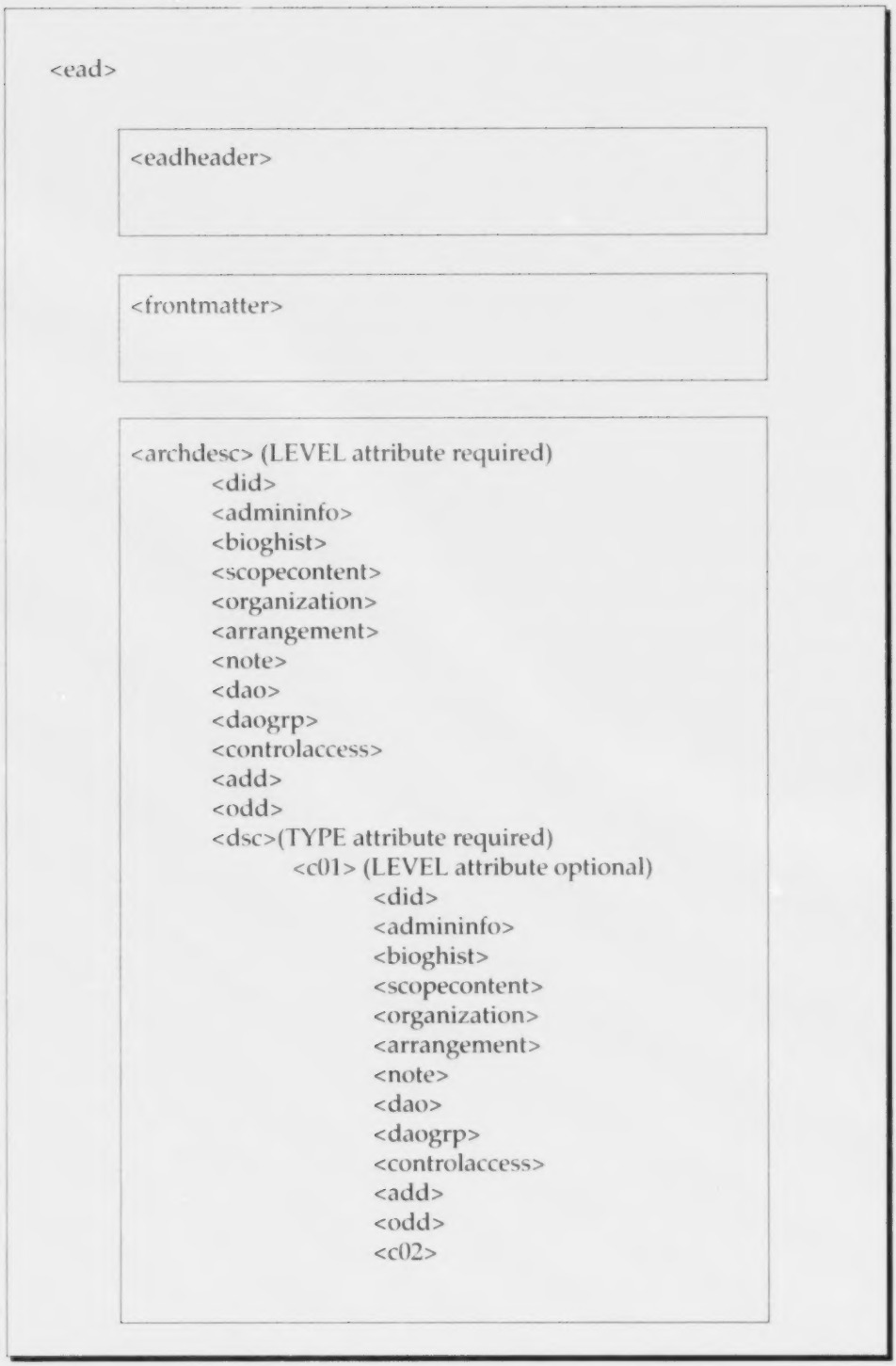

Fig. 3. High-level model for the encoded archival description document type definition (Society of American Archivists Encoded Archival Description Working Group 1999)

Utility of the Archival Paradigm in the Digital Environment

> Information is not a natural category whose history we can extrapolate. Instead, information is an element of certain professional ideologies . . . and cannot be understood except through the practices within which it is constructed by members of those professions in their work.
>
> —Agre (1995)

The principles and practices discussed in the preceding section demonstrate how the archival community constructs information and why this construction needs to be understood and addressed in the digital environment. These principles and practices, independent of the archival construction of information, can also contribute to the management of digital information. Implementing the archival paradigm in the digital environment encompasses the following:

- working with information creators to identify requirements for the long-term management of information;
- identifying the roles and responsibilities of those who create, manage, provide access to, and preserve information;
- ensuring the creation and preservation of reliable and authentic materials;
- understanding that information can be dynamic in terms of form, accumulation, value attribution, and primary and secondary use;
- recognizing and exploiting the organic nature of the creation and development of recorded knowledge;
- identifying evidence in materials and addressing the evidential needs of materials and their users through archival appraisal, description, and preservation activities; and
- using collective and hierarchical description to manage high volumes of nonbibliographic materials, often in multiple media.

The archival community is making significant contributions to research and development in the digital information environment by using integrity, metadata, knowledge management, risk management, and knowledge preservation. Each area is discussed below with reference to recent and ongoing projects in which the archival community has played a leading role in setting the agenda or integrating the archival perspective. Many of the projects discussed have in common a concern for evidence in information creation, storage, retrieval, and preservation; cross-community collaboration; strategies that use both technological processes and management procedures; development of best practices and standards; and evaluation.

Integrity of Information

> Integrity requires a degree of openness and auditability as well as accessibility of information and records for public inspection, at

> least within the context of specific review processes. Integrity in an information distribution system facilitates and insures the ability to construct and maintain a history of intellectual dialog and to refer to that history over long periods of time.
>
> —Lynch (1994)

Ensuring the integrity of information over time is a prominent concern in the digital environment because physical and intellectual integrity can easily be consciously or unconsciously compromised and variant versions can easily be created and distributed. This concern has two aspects—checking and certifying data integrity (associated with technical processes such as integrity checking, certification, digital watermarking, steganography, and user and authentication protocols) and identifying the intellectual qualities of information that make it authentic (associated with legal, cultural, and philosophical concepts such as trustworthiness and completeness).

Functional requirements are particularly well articulated in highly regulated communities such as the pharmaceutical and bioengineering industries. Less well explored is how to identify and preserve the intellectual integrity of information. The intellectual mechanisms by which we come to trust traditional forms of published information include a consideration of provenance, citation practices, peer review, editorial practices, and an assessment of the intellectual form of the information. In the digital environment, information may not conform to predictable forms or may not have been through traditional publication processes; a more complex understanding of information characteristics and management procedures is required for the intellectual integrity of information to be understood. Attempts are often made to implement digital versions of procedures traditionally used in record keeping and archival administration. Such attempts include establishing trusted servers or repositories that can serve as a witness or notary public; distributing information to multiple servers, thus making it harder to damage or eliminate all copies; developing certified digital archives as trusted third-party repositories; and identifying canonical versions of information resources (Commission on Preservation and Access and Research Libraries Group 1996, Lynch 1994).

Project Prism

Project Prism at Cornell University is concerned with issues of information integrity within digital libraries. It is a four-year collaborative project involving librarians, archivists, computer scientists, evaluation experts, and international testbed participants. The project was recently funded through the National Science Foundation's Digital Library Initiative to investigate and develop policies and mechanisms for information integrity in digital libraries. The project will focus on five areas (Project Prism 1999):

- *preservation*: long-term survivability of information in digital form;
- *reliability*: predictable availability of information resources and services;

- *interoperability*: open standards that allow the widest sharing of information among providers and users;
- *security*: attention to the privacy rights of information users and the intellectual property rights of content creators; and
- *metadata*: structured information that ensures information integrity in digital libraries.

International Project on Permanent Records in Electronic Systems (InterPARES)

The International Project on Permanent Records in Electronic Systems (InterPARES) is a three-year project using archival and diplomatics principles to examine the characteristics inherent in digital information objects created by electronic record-keeping technologies in order to establish their authenticity and how that authenticity might be maintained over time. The project is funded by several agencies, including the U.S. National Historical Records and Publications Commission and Canada's Social Sciences and Humanities Research Consortium. An interdisciplinary team of researchers drawn from archival science, preservation management, library and information science, computer science, and electrical engineering is working with an industry group (primarily the pharmaceutical and biocomputing industries) and major archival repositories, including the national archives of several countries.

The project builds on previous research conducted at the University of British Columbia that examined the preservation of the integrity of electronic records and theoretically defined the concepts of reliability and authenticity in relation to electronic records. It also identified the procedural requirements and responsibilities for ensuring the reliability of active records and the authenticity of preserved records. The philosophy underlying InterPARES is that the theories and methodologies necessary to ensure the long-term preservation of authentic electronic records must be centered on the nature and meaning of the records themselves. Despite the new media and formats of electronic records, from the perspective of archival science the integral components that identify and authenticate a record have not changed. By combining principles of diplomatics and archival principles, the project is developing a template that can be used to identify requirements for authenticity for different kinds of electronic records and systems that generate records. To use this template and to understand the extent to which electronic records resemble traditional records, the project is analyzing a variety of electronic information and record-keeping systems, including large-scale object-oriented databases, geographic information systems, dynamic Web resources, and digital music systems in many national legal and organizational contexts. These analyses will be translated into recommended systems-design requirements and authentication processes, record-keeping policies and procedures, and preservation strategies for different types of records (InterPARES Project 1999). Different preservation processes will also be evaluated to ascertain their ability to maintain the elements of different types of records identified as

essential to preserving the records' authenticity. Although this project is focused on the authenticity requirement of records rather than on more generic forms of information, its findings will likely be relevant to digital information or information systems that need to retain the integrity of physical and intellectual characteristics over time.

Metadata

> I would contend that most objects of culture are . . . embedded within context and those contexts are embedded within other ones as well. So a characteristic of cultural objects is they're increasingly context-dependent. And they're increasingly embedded in meta-languages.
>
> —Brian Eno (1999)

The term metadata has different meanings depending on the community using it. The library community frequently uses metadata to refer to cataloging and other forms of descriptive information, but it is also used to refer to information about the administration, preservation, use, and technical functionality of digital information resources (Gilliland-Swetland 1998).

With the increasing diversity of distributed and interactive digital information systems comes a need for a metadata infrastructure that can implement the functional requirements of each information community and promote interoperability. The challenge is not just to identify the areas where it is possible to map between different types of metadata. It is also necessary to identify the tensions between the rich and complex metadata sets that individual communities have developed and the need for simpler metadata sets that are easier for nonspecialists to use and systems designers to maintain. For information communities that work with cultural information there are several important elements in ensuring authenticity and facilitating the use of an information object. They include metadata such as contextual description, indications of relationships between collections of materials, annotations that have accrued around information objects, documentation of intellectual property rights, and documentation of processes that the information objects have undergone, such as reformatting and migration. Rich metadata sets that incorporate aspects such as these are essential if the object is to be used to its fullest potential. However, considerable demand exists for leaner metadata that will enable users to move between information systems that might contain different types of materials on the same subject. Some of the most interesting questions that arise from such considerations include the following:

- How much of the metadata needs to exist in time and over time to support the evidential qualities of the information?
- Where should the necessary metadata reside (within the digital information system, in paper form, or both)?

- To what extent are metadata integral components of the information object? (Where does the information object end and the metadata begin?)
- To what extent should information professionals be engaged in the design and creation of metadata for the systems that create information objects to ensure that those objects can be managed and preserved later in life?
- How can metadata help to ensure that information objects are used optimally by diverse users?

Two examples that illustrate the contributions that archivists have made in the area of metadata are EAD and a suite of metadata projects that were recently conducted in Australia.

Encoded Archival Description (EAD)

Described earlier in this report, EAD is a new archival descriptive standard adopted in the United States and being developed as a potential international standard. A hierarchical, object-oriented way of describing the context and content of archival collections, EAD can be a flexible metadata infrastructure for integrating descriptions with actual digital and digitized archival materials within an archival information system. It can also be mapped into other metadata structures such as MARC. Perhaps EAD's greatest potential lies in its ability to be manipulated for information retrieval and display without compromising how it documents the provenance, original order, and organic nature of archival collections. As a result, it moves beyond the static concept of the paper finding aid and can facilitate appropriate access for diverse users at the collection and item levels (Gilliland-Swetland 2000b, Pitti 1999).

A measure of the utility and sophistication of EAD is the interest it has created in other professional communities. The Online Archive of California (OAC), now part of the California Digital Library, is an example of a multi-institutional database containing encoded finding aids and digitized content drawn from archives and special collections of the University of California, California State University, and numerous other universities and repositories throughout the state. The size and scope of OAC have enabled it to develop best practices for encoding and model evaluation processes and to examine its own usability not only as a scholarly resource but also as a resource for K-12 education. (Gilliland-Swetland 2000a, Online Archive of California 1999). A constituent OAC project, Museums in the Online Archive of California (MOAC), which is being conducted by several museums across California, is applying EAD to the description of museum collections. This development has the potential not only to map between the descriptive practices of two professional communities but to integrate access to intellectually related two- and three-dimensional historical and cultural resources that have often been located in different institutions.

SPIRT Recordkeeping Metadata Standards Project

Over the past five years, several metadata projects conducted in Australia have built on the records continuum model by specifying, standardizing, and integrating into active electronic record-keeping systems the kinds of metadata necessary for effective record keeping and for ensuring the long-term management and archival use of essential evidence. These projects include the Victoria Electronic Records Strategy metadata set and the Australian Government Locator System. The most recent of these projects is the SPIRT (Strategic Partnership with Industry—Research and Training) Recordkeeping Metadata Standards Project for Managing and Accessing Information Resources in Networked Environments Over Time for Government, Commerce, Social and Cultural Purposes, directed by Monash University in association with the National Archives of Australia. This project builds on the work of previous projects and provides a framework for standardizing sets of interoperable record-keeping metadata that can be associated with records from creation through processes such as embedding, encapsulation, or linking to metadata stores. Metadata elements are classified by purpose and are being mapped against related generic and sector-specific metadata sets such as Dublin Core (Records Continuum Research Group 1999). In this way, archivists build a business case for including archival considerations in the workflow because of the need to manage risk and the role of records in supporting organizational decision making.

Knowledge Management

Like the term metadata, the term knowledge management is being widely used, although its meaning and how it differs from information management are less than clear. Knowledge management refers to the practices, skills, and technologies associated with creating, organizing, storing, presenting, retrieving, using, preserving, disposing of, and re-using information resources to help identify, capture, and produce knowledge. Knowledge management is often used to create entrepreneurial opportunities by identifying and exploiting an organization's knowledge capital. Knowledge management activities can include data and metadata mining as well as digital asset management. In many respects, such activities are a logical extension of records management and archival activities such as those under way in Australia. The rationales for building and sustaining electronic records and other digital information resources are derived not only from abstract concepts of information and research needs but from administrative and legal necessity, the corporate bottom line, and institutional or repository enterprise.

Knowledge management systems are often hybrids of born-digital, digitized, and traditional media in the form of organizational records, nonrecord information, and digital products (such as publications or movies). Such systems include digital images and texts as well as sound, moving images, graphics, and animation. They also contain procedural and administrative information such as rights

management for digital assets. Whereas digital libraries are built around assumptions about current and potential uses but with few hard data, digital asset management systems are created organically out of organizational activities and the need for agility sufficient to respond to emerging institutional priorities. This way of looking at information resources—regarding their content and metadata as assets with dynamic values and market demand—is a different mindset for many information professionals. It involves adopting a holistic rather than a piecemeal approach to information systems and shifting from a linear to an organic perspective.

The digital asset management approach has been extensively developed by the media industries, particularly publishing and entertainment, where both the product and the information and records associated with its production are primarily digital. In the entertainment industry, studios are hiring archivists with experience in electronic records management to build digital asset management or metadata management systems for the assets created during production. In some cases, a two-phase approach is adopted whereby digital production is handled in a production management system and its contents are created, described, and organized by the primary users. After production is completed, all associated materials are transferred to the asset management system, where the digital asset manager or digital archivist organizes and describes them for secondary use. Metadata are developed to track levels and types of use and allow maximum flexibility in retrieving and interrelating assets.

This approach has tremendous potential for supporting the vision, relevance, utility, and sustainability of digital library and archives resources. It incorporates the interests of the information creator and makes preservation management integral to creation and retention. It offers a new economic and use-based framework to help institutions prioritize selection of information content and decide what and how much metadata to create; which resources to keep online; and which assets to preserve, purge, or allow to decay gradually.

Risk Management

> If archivists are to take their rightful place as regulators of an organization's documentary requirements, they will have to reach beyond their own professional literature and understand the requirements for recordkeeping imposed by other professions and society in general. Furthermore, they will have to study methods of increasing the acceptance of their message and the impact and power of warrant.
>
> —Duff (1998)

Evaluation practices of library and information retrieval systems have traditionally been based on four factors—effectiveness, benefits, cost-effectiveness, and cost benefits (Lancaster 1979). Research on electronic archival records has postulated another form of evaluation—risk management—borrowed from professions such as audit-

ing, quality control, insurance, and law. Although this concept has not been applied directly to other information environments, it has implications for assessing risk in terms of ensuring the reliability and authenticity, appropriate elimination, and preservation of digital information.

Archivists seeking to develop blueprints for the management of electronic records have undertaken several important projects in recent years. This research showed that electronic records are likely to endure with their evidential value intact beyond their active life only if functional requirements for record-keeping systems design and policies and procedures for record keeping are addressed during the design and implementation of the system. This increases the likelihood that appropriate software and hardware standards will be used, making the records easier to preserve. Records will also be created in such a way that they can be identified, audited, rendered immutable on completion, physically or intellectually removed, and brought under archival control.

Missing from this approach is the motivation for organizations to invest the resources required to implement expensive archival requirements in their active record-keeping systems. With the digital asset management approach discussed previously, the motivation to preserve usable digital information comes from the organization itself and is intimately tied to enterprise management. The Australian metadata projects apply two other strategies. The first is demonstrating that well-designed record-keeping systems and metadata will enhance organizational decision making. The second is risk management: persuading the organization that the resources invested in electronic record keeping will reduce the organizational risk incurred by not complying with archival and record-keeping requirements. Organizations such as public bodies and regulated industries are generally aware of the penalties for noncompliance. Noncompliance by a public body could result in a costly lawsuit. Noncompliance by a regulated industry could result in not getting regulatory approval to market a new product. The cost of noncompliance with record-keeping requirements may be significantly higher than that of compliance. In other environments the risk analysis may be less straightforward because the risks may be less evident or the costs of noncompliance less tangible.

The risk management approach developed by the Recordkeeping Functional Requirements Project at the University of Pittsburgh between 1993 and 1996 greatly influenced subsequent electronic record-keeping research and development projects, including the Australian metadata projects. The Pittsburgh project was an inductive project based on case studies, expert advice, precedents, and professional standards (Cox 1994). There were four main products of the research:

- functional requirements—a list of conditions that must be met to ensure that evidence of business activities is produced when needed;

- a methodology for devising a warrant for record keeping derived from external authorities such as statutes, regulations, standards, and professional guidelines;
- unambiguous production rules formally defining the conditions necessary to produce evidence so that software can be developed and the conditions tested; and
- a metadata set for uniquely identifying and explaining terms for future access and for using and tracking records.

The contribution of the Pittsburgh project, beyond the development of the functional requirements and metadata set was the development of the concept of warrant and a methodology for creating a warrant relevant to the individual circumstances of an organization. Warrant relates to the requirements imposed on an organization by external authorities for creating and keeping reliable records. If organizations understand warrant regarding how they manage their electronic record-keeping systems, they can assess the degree of risk they might incur by not managing their systems appropriately (Duff 1998).

Knowledge Preservation

> The digital world transforms traditional preservation concepts from protecting the physical integrity of the object to specifying the creation and maintenance of the object whose intellectual integrity is its primary characteristic.
>
> —Conway (1996)

Preservation is arguably the single biggest challenge facing everyone who creates, maintains, or relies on digital information. Awareness of the immense scope of the potential preservation crisis has brought many groups together to experiment with new preservation strategies and technologies. Preserving knowledge is more complex than preserving only media or content. It is about preserving the intellectual integrity of information objects, including capturing information about the various contexts within which information is created, organized, and used; organic relationships with other information objects; and characteristics that provide meaning and evidential value. Preservation of knowledge also requires appreciating the continuing relationships between digital and nondigital information.

The archival mission of preserving evidence over time has resulted in demanding criteria for measuring the efficacy of the range of strategies now being discussed for digital preservation, including migration, emulation, bundling, and persistent object preservation. Projects using archival testbeds are under way in several countries with the aim of understanding the extent to which different strategies work with a range of materials and what limitations need to be addressed procedurally, through the development of new technological approaches, or both.

The Cedars Project

The Cedars Project is a United Kingdom collaboration of librarians, archivists, publishers, authors, and institutions (libraries, records offices, and universities). Working with digitized and born-digital materials, Cedars is using a two-track approach to evaluate different preservation strategies through demonstration projects at U.K. test sites; develop recommendations and guidelines; and develop practical, robust, and scaleable models for establishing distributed digital archives (Cedars Project 1999). Cedars is also examining other issues related to the management of digital information, including rights management and metadata.

The Digital Repository Project

The Digital Repository Project of the National Archives of the Netherlands is concerned with the authenticity, accessibility, and longevity of archival records created by Dutch government agencies. The project brings together two important concepts—the emulation technique devised by Jeff Rothenberg and the reference model for an open archival information system (OAIS) developed by the U.S. National Aeronautics and Space Administration, which is being adopted as an ISO standard. The emulation technique involves creating emulators for future computers to enable them to run the software on which archived material was created and maintained, thus recreating the functionality, look, and feel of the material (Rothenberg 1995 and 1999). The OAIS reference model is a high-level record-keeping model developed to assist in the archiving of high-volume information. It delineates the processes involved in the ingestion, storage, administrative and logistical maintenance, intellectual metadata management, and access and delivery of electronic records (Sawyer and Reich 1999).

The Digital Repository Project is most concerned with determining the functionality of the repository, scope of the metadata, standards to be applied, and differentiation of the intellectual and the physical and technical form of the records. As with the Cedars Project, a two-track approach is being taken. One track will build a small repository to preserve simple records in a stand-alone environment implemented by the National Archives. The other track will develop a testbed and experimental framework for examining preservation strategies such as migration, emulation, and XML on electronic records acquired by applying the OAIS reference model (Hofman 1999).

Persistent Object Preservation

Persistent object preservation is a highly generic technological approach that has been developed jointly by the U.S. National Archives and Records Administration and the San Diego Supercomputer Center. This project is addressing the need of the National Archives to find efficient and fast methods for acquiring and preserving, in context, millions of files that can be applied to many types of records and that comply with archival principles. The approach focuses on

storing the information objects that make up a collection and identifying their metadata attributes and behaviors that can be used to recreate the collection.

Like the Digital Repository Project, persistent object preservation is built around the OAIS reference model. It supports archival processes from accessioning through preservation and use, and it recognizes the importance of collection-based management. Persistent object preservation also exploits inherent hierarchical structures within records, predictable record forms, and dependencies between them. It is designed to be consistent, comprehensive, and independent of infrastructure (Rajasekar et al. 1999, Thibodeau 1999).

Achieving the Full Potential of Cross-Community Developments in the Digital Environment

> The long-term preservation of information in digital form requires not only technical solutions and new organizational strategies, but also the building of a new culture that values and supports the survival of bits over time. This requires that a diverse community of experts—computer scientists, archivists, social scientists, artists, lawyers, and politicians—collaborate to ensure the preservation of a new kind of cultural heritage, the digital document.
>
> —Lyman and Besser (1998)

Much of this report has focused on explicating the archival perspective and demonstrating how it can contribute to the management of digital information. It has also pointed out some of the opportunities resulting from the extension of archival principles to the management of electronic records. A similar explication of the perspectives and functional requirements for digital information and information systems of other information communities, such as museum professionals, preservationists, and systems designers, is now needed. This will enable everyone engaged in the digital environment to see points of commonality and divergence and develop technological, procedural, policy, and educational approaches accordingly.

Several other activities would assist in this endeavor. First, more opportunities are needed for cross-community dialog on issues relating to the development of digital information infrastructure. Such dialog has increased in recent years, as shown by the development of the Dublin Core, the ongoing debate over intellectual property in the digital environment, and the collaborative projects mentioned above. Workshops and conferences hosted by the Council on Library and Information Resources, National Science Foundation, and Northeast Document Conservation Center, among others, have brought the different communities together to discuss key issues such as digital preservation and access. More could be done, however, to bring together rank-and-file members of the professional communities.

Second, identifying substantive documentation on the various projects under way can be difficult despite the presence of substantial project Web sites. A clearinghouse of project-related papers, especially final reports, would help, as would additional interdisciplinary publishing outlets.

Third, and perhaps most important, professional education and continuing education mechanisms need to be reevaluated. A new kind of professional is needed, one whose primary domain is the information metacommunity and who can function effectively in the dynamic interdisciplinary information environment. This might involve

- changing the core curricula in library and information science programs to include additional professional perspectives,
- developing more intensive education in archival science and museum administration under a more interdisciplinary rubric such as information studies, and
- developing new interdisciplinary or interprofessional programs.

Similarly, a pressing need exists to develop effective mechanisms for keeping practicing professionals abreast of techniques and issues in the digital environment. The information professions lack a coherent continuing education infrastructure to systematically address this need.

Summary

The archival community has come a long way in the past 200 years. Challenged by increasingly rapid changes in record-keeping and reproduction technologies as well as by changes in bureaucratic structures and collaborative processes, the archival paradigm has evolved into a sophisticated and confident articulation of an evidence-based approach to information management. The archival community has made the following important contributions individually and collaboratively:

- articulating functional requirements for information systems and records creation processes to ensure the reliability and authenticity of records and the preservation of their evidential value,
- providing testbeds for implementing and evaluating preservation techniques and technologies,
- exploiting the roles of context and hierarchy in information retrieval, and
- developing interoperable metadata.

Such contributions demonstrate the relevance and utility of the archival perspective in the digital environment and argue for consideration of its principles and practices in the development of a new paradigm for the emerging metacommunity of information professionals.

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